2. Program Implementation

Introduction

The CCT Program founding principles and implementing process resulted in one of the most successful cost-shared government/industry partnerships forged to respond to critical national needs. Through five nationwide competitions, a total of 60 government/industry cost-shared projects were selected, of which 40, valued at more than $5.4 billion have either been completed or remain active at the end of fiscal year 1999. For the 40 projects, the industry cost-share is an unprecedented 66 percent. Sixty percent of the projects (24) have successfully completed operations. The balance are moving forward, with operational testing under way for six projects.

Over the nine-year period of soliciting and awarding projects, the thrust of the environmental concerns relative to coal use have changed. Nevertheless, the implementing process allowed the program to remain responsive to the changing needs. The result is a portfolio of technologies and a database of technical and cost information that will enable coal to remain a major contributor to the U.S. energy mix without being a threat to the environment. This result will ensure secure, low-cost energy requisite to a healthy economy well into the 21st century.

Success of the CCT Program is measured by the degree to which the operational, environmental, and economic performance of a technology can be projected for commercial applications. Decision makers must have a sufficient database to project performance and assess risk for commercial introduction and deployment of new technologies. This need was a driving force in establishing the principles that created the foundation for the implementation process. The government role is non-traditional, moving away from a command-and-control approach to a performance-based approach, where the government sets performance objectives and industry responds with its ideas and is allowed broad latitude in technical management of the projects. This approach encourages technology innovation and cost-sharing. Industry and the public play major roles in the process, reflecting their respective roles in moving technologies into the marketplace.

Implementation Principles

The principles underlying the CCT Program were developed after much study of previous government demonstration programs, assessing both positive and negative results. The principles represent a composite of incentives and checks and balances that allows all participants to best apply their expertise and resources. These guiding principles are outlined below.

- **A strong and stable financial commitment exists for the life of the projects.** Full funding for the government's share of selected projects was appropriated by Congress at the start of the program. This up-front commitment has been vital to getting industry's response in terms of quantity and quality of proposals received and the achievement of 66 percent cost-sharing.
- **Multiple solicitations spread over a number of years enabled the program to address a broad range of national needs with a portfolio of evolving technologies.** Allowing time between solicitations enabled Congress to adjust the goals of the program to meet changing national needs; provided DOE time to revise the implementation process based on lessons learned in prior solicitations; and provided industry the opportunity to develop better projects and more confidently propose evolving technologies.
- **Demonstrations are conducted at commercial scale in actual user environments.** Typically, a technology is constructed at commercial scale with full system integration, reflective of its intended commercial configuration, and operated as a commercial facility or installed on an existing commercial facility. This enables the technology's performance potential to be judged in the intended commercial environment.
- **The technical agenda is determined by industry and not the government.** Based on goals established by Congress and policy guidance received, DOE set definitive performance objectives and performance-based evaluation criteria against which proposals would be judged. Industry was given the flexibility to use their expertise and innovation to define the technology and proposed project in response to the objectives and criteria. DOE

selected the projects based on those that best met the evaluation criteria.

- **Roles of the government and industry are clearly defined and reflect the degree of cost-sharing required.** The government plays a significant role up front in structuring the cooperative agreements to protect public interests. This includes negotiating definitive performance milestones and decision points throughout the project. Once the project begins, the industrial participant is responsible for technical management, while the government oversees the project through aggressive monitoring and engages in implementation only at decision points. Continued government support is assured as long as project milestones and the terms and conditions of the original cooperative agreement continue to be met.
- **At least 50 percent cost-sharing by industry is required throughout all project phases.** Industry's cost-share was required to be tangible and directly related to the project, with no credit for previous work. By sharing essentially in each dollar expended along the way, on at least an equal basis, industry's commitment to fulfilling project objectives was strengthened.
- **Allowance for cost growth provides an important check-and-balance feature to the program.** Statutory provisions allow for additional financial assistance beyond the original agreement in an amount up to 25 percent of DOE's original contribution. Such financial assistance, if provided, must be cost-shared by the industrial participant at no less than the cost-share ratio of the original cooperative agreement. This statutory provision recognizes the risk involved in first-of-a-kind demonstrations by allowing for cost growth. At the same time, it recognizes the need for the industrial participant's commitment to share cost growth and limits the government's exposure.
- **Industry retains real and intellectual property rights.** The level of cost-sharing warrants the industrial participant retaining intellectual and real property rights and removes potential constraints to commercialization. Industry would otherwise be reluctant to come forward with technologies they have developed to the point of demonstration, relinquishing their competitive position.
- **Industry must make a commitment to commercialize the technology.** Consistent with program goals, the industrial participant is required to make the technology available on a nondiscriminatory basis to all U.S. companies that seek, under reasonable terms and conditions, to use the technology. While the technology owner is not forced to divulge know-how to a competitor, the technology must be made available to potential domestic users on reasonable commercial terms.
- **Upon successful commercialization of the technology, repayment up to the government's cost-share is required.** The repayment obligation occurs only upon successful commercialization of the technology. It is limited to the government's level of cost-sharing and the 20-year period following the demonstration.

In summary, these principles provide built-in checks and balances to ensure that the industry and government roles are appropriate and that the government serves as a risk-sharing partner without impeding industry from using its expertise and getting the technology into the marketplace.

Implementation Process

Significant public and private sector involvement was integral to the process leading to technology demonstration and critical to program success. Even before engaging in a solicitation, a public process was instituted under the National Environmental Policy Act (NEPA) to review the environmental impacts. A programmatic environmental impact assessment (PEIA), followed by a programmatic environmental impact statement (PEIS), was prepared prior to initiating solicitations. Public comment and resolution of comments were required prior to proceeding with the program.

As to the solicitation process, Congress set the goals for each solicitation in the enabling legislation and report language (see Appendix A for legislative history and Appendix B for program implementation history). The Department of Energy translated the congressional guidance and direction into performance-based criteria, and developed approaches to address lessons learned from previous solicitations. Before proceeding with a solicitation, however, an outline of the impending solicitation and attendant issues and options was presented in a series of regional public meetings to obtain feedback. The public meetings were structured along the lines of workshops to

facilitate discussion and obtain comments from the broadest range of interests. Comments from the public meetings then were used in preparing a draft solicitation, which in turn was issued for public comment. Comments received were formally resolved prior to solicitation issuance.

To aid proposers, preproposal conferences were held for the purpose of clarifying any aspects of the solicitation. Further, every attempt was made in the solicitation to impart a clear understanding of what was being sought, how it would be evaluated, and what contractual terms and conditions would apply. A section of the solicitation was devoted to helping potential proposers determine technology eligibility, and numerical quantification of the evaluation criteria was provided. The solicitation also contained a model cooperative agreement with the key relevant contractual terms and conditions.

Project selection and negotiation leading to award were conducted under stringent rules carrying criminal penalties for noncompliance. Proposals were evaluated and projects negotiated strictly against and within the criteria and terms and conditions established in the solicitation. In the spirit of NEPA, information required and evaluated included project-specific environmental, health, safety, and socioeconomic aspects of project implementation.

Upon project award, another public process was engaged to ensure that all site-specific environmental concerns were addressed. The National Environmental Policy Act requires that a rigorous environmental assessment be conducted to address all potential environmental, health, safety, and socioeconomic impacts associated with the project. The findings can precipitate a more formal environmental impact statement (EIS) process, or the findings can remain as an environmental assessment (EA) along with a finding of no significant impact (FONSI). During the EIS process, public meetings are held for the purpose of disclosing the intended project activities, with emphasis on potential environmental, health, safety, socioeconomic impacts, and planned mitigating measures. Comments are sought and must be resolved before the project can proceed. This process has led to additional actions taken by the industrial participants beyond the original project scope. To facilitate the NEPA process, DOE encouraged environmental data collection through cost-sharing during the negotiation period contingent upon project award.

Because of the environmental nature of the CCT Program, DOE took a proactive posture in carrying out the principles of NEPA. Environmental concerns were aggressively addressed and the public engaged prior to major expenditure of public funds. Furthermore, DOE required that an in-depth environmental monitoring plan (EMP) be prepared, fully assessing potential pollutant emissions, both regulated and unregulated, and defining the data to be collected and the methods for collection. All cooperative agreements required preparation of environmental monitoring reports that provide results of the monitoring activities. As environmental issues emerged, every effort was made to address them directly with the understanding that commercial technology acceptance hinged on satisfying users and the public as to acceptable environmental performance. Appendix C reviews the proactive environmental stance taken by the program, further delineates the NEPA process, and provides the status of key actions.

▼ The NEPA process assured environmental acceptability of the Healy Clean Coal Project on the border of Denali National Park in Alaska.

Projects are managed by the participants, not the government. However, public interests are protected by requiring defined periods of performance referred to as budget periods, throughout the project. Budget periods are keyed to major decision points. A set amount of funds is allotted to each budget period, along with performance criteria to be met before receiving funds for the next budget period. These criteria are contained in project evaluation plans (PEPs). Progress reports and meetings during budget periods serve to keep the government informed. At the decision points, progress against PEPs is formally evaluated, as is the PEP for the next budget period. Financial data is also examined to ensure the participants' capability to continue required cost-sharing. Failure to perform as expected results in greater government involvement in the decision making process. Proposal of major project changes precipitates not only in-depth programmatic assessment, but legal and procurement review as well. Decisions regarding continuance into succeeding budget periods, any increase in funding, or major project changes require the approval of DOE's Assistant Secretary of Fossil Energy.

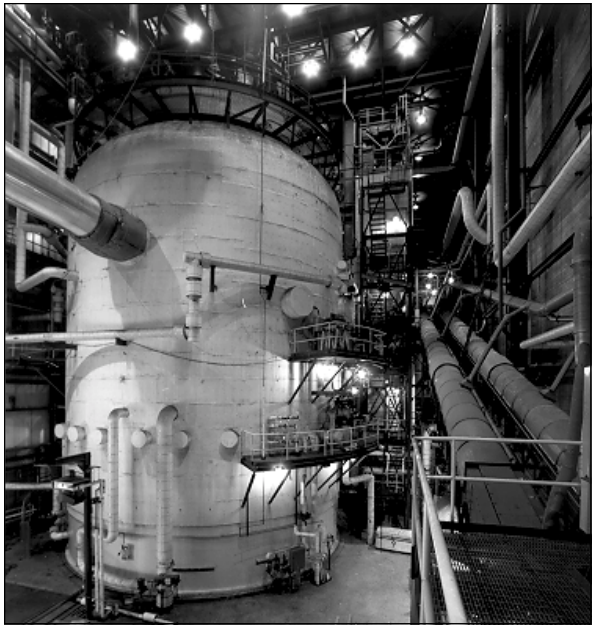
Beyond the formal process associated with the solicitations, parallel efforts were conducted to inform stakeholders of ongoing events, results, and issues and to engage them in discussion on matters pertinent to ensuring that the program remained responsive to needs. A continuing dialog was facilitated by direct involvement in the projects of a large number of utilities, technology suppliers, and states, as well as key industry-based research organizations (e.g., the Electric Power Research Institute and Gas Research Institute). This was accompanied by executive seminars designed to enhance communications with the utility, independent power producer, regulatory, insurance underwriter, and financial sectors. The approach was to identify those sectors where inputs were missing and then structure seminars to provide information on the program and obtain the executives' perspectives and suggestions for enhancing program performance. Furthermore, an annual CCT Conference was instituted to serve as a forum for reporting project progress and results and discussing issues affecting the outcome of the CCT Program. And, an outreach program was put in place to ensure that needed information was prepared and disseminated in the most efficient manner, leveraging a variety of domestic and international conferences, symposia, and workshops. These activities are discussed in further detail in Section 4.

During implementation of the CCT Program, many precedent-setting actions were taken and many innovations were used by both the public and private sectors to overcome procedural problems, create new management systems and controls, and move toward accomplishment of shared objectives. The experience developed in dealing with complex business arrangements of multi-million dollar CCT projects is a significant asset that has contributed greatly to the CCT Program's success—an asset of value to other programs seeking to forge government/industry partnerships. To document lessons learned, *Clean Coal Technology Program Lessons Learned* was published in July 1994. This report documents the knowledge acquired over the course of the CCT Program through the completion of five solicitations. The report was based on the belief that it is of mutual advantage to the private and public sectors to identify those factors thought to contribute to the program's success and to point out pitfalls encountered and corrective actions taken.

Commitment to Commercial Realization

The CCT Program has been committed to commercial realization since its inception. The significant environmental, operational, and economic benefits of the technologies being demonstrated in the program will be realized when the technologies achieve widespread commercial success. The importance attached to commercial realization of clean coal technologies is highlighted in Senate Report 99-82, which contains the following recommendation for project evaluation criteria: "[t]he project must demonstrate commercial feasibility of the technology or process and be of commercial scale of such size as to permit rapid commercial scale-up."

The commitment to commercial realization recognizes the complementary but distinctive roles of the technology owner and the government. It is the technology owner's role to retain and use the information and experience gained during the demonstration and to promote the use of the technology in the domestic and international marketplaces. The detailed operational, economic, and environmental data and the experience gained during the demonstration are vital to efforts to commercialize the technology. The government's role is to capture, assess, and transfer operational, economic, and environmental information to a broad spectrum of the private sector and international community. The information must be sufficient to allow potential commercial users to confidently screen the technologies and to identify those meeting operational requirements. The importance of commercial realization is confirmed by the requirement in the solicitations and cooperative agreements that the project participant must pursue commercialization of the technology after successful demonstration.



▲ The results of the Tidd PFBC Demonstration Project have helped pave the way to 10 other projects worldwide. The pressure vessel from Tidd is shown above.

Each of the five solicitations contained requirements for the project proposals to include a discussion of the commercialization plans and approaches to be used by the participants. The proposer was required to discuss the following topics:

- The critical factors required to achieve commercial deployment, such as financing, licensing, engineering, manufacturing, and marketing;
- A timetable identifying major commercialization goals and schedule for completion;
- Additional requirements for demonstration of the technology at other operational scales, as well as significant planned parallel efforts to the demonstration project, that may affect the commercialization approach or schedule; and
- The priority placed by senior management on accomplishing the commercialization effort and how the project fits into the various corporations' business, marketing, or energy utilization strategies.

The cooperative agreement contains three mechanisms to ensure that the demonstrated technology can be replicated by responsible firms while protecting the proprietary commercial position of the technology owner. These three mechanisms are:

- The commercialization clause requires the technology owner to meet U.S. market demands for the technology on a nondiscriminatory basis (this clause "flows down" from the project participant to the project team members and contractors);
- The clauses concerning rights to technical data deal with the treatment of data developed jointly in the project as well as data brought into the project; and
- The patent clause affords protection for new inventions developed in the project.

In addition to ensuring implementation of the above project-specific mechanisms, the government role also includes disseminating the operational, environmental, and economic performance information on the technologies to potential customers and stakeholders. To carry out this role, a CCT Outreach Program was established to perform the following functions:

- Make the public and local, state, and federal government policy makers aware of the CCTs and their operational, economic, and environmental benefits;
- Provide potential domestic and foreign users of the technologies with the information needed for decision making;
- Inform financial institutions and insurance underwriters about the advancements in technology and associated risk mitigation to increase confidence; and
- Provide customers and stakeholders opportunities for feedback on program direction and information requirements.

Specific accomplishments of the CCT Outreach Program are discussed in Section 4.

▲ Publications keep stakeholders informed of CCT Program demonstration results.

▲ Exhibits communicate the progress of the CCT Program at worldwide conferences and trade shows.

Solicitation Results

Each solicitation was issued as a Program Opportunity Notice (PON)—a solicitation mechanism for cooperative agreements where the program goals and objectives are defined but the technology is not. Proposals for demonstration projects consistent with the objectives of the PON were submitted to DOE by specific deadlines. DOE evaluated, selected, and negotiated projects strictly within the bounds of the PON provisions. Award was made only after Congress was allowed 30 in-session days to consider the projects as outlined in a *Comprehensive Report to Congress* issued after each solicitation.

Exhibit 2-1 summarizes the results of solicitations. Exhibit 2-2 identifies the projects currently in the CCT Program and the solicitation under which the projects were selected. Appendix B provides a summary of the procurement history and a chronology of project selection, negotiation, restructuring, and completion or termination. Project sites are mapped in Exhibits 2-3 through 2-6, which indicate the geographic locations of projects by application category.

▲ *Comprehensive Report to Congress* was issued after each solicitation for each selected project.

Exhibit 2-1
CCT Program Selection Process Summary

Solicitation	PON Issued	Proposals Submitted	Projects Selected	Projects in CCT Program as of Sept. 30, 1999
CCT-I	February 17, 1986	51	17	8
CCT-II	February 22, 1988	55	16	9
CCT-III	May 1, 1989	48	13	13
CCT-IV	January 17, 1991	33	9	6
CCT-V	July 6, 1992	24	5	4
		211	60	40

The resultant projects have achieved broad-based industry involvement. More than 55 individual electric generators serving 33 states have participated in the program. These utilities generate more than 178,000 MWe, approximately 25 percent of U.S. capacity, and consume about 36 percent of the coal produced domestically. Also participating were over 50 companies supplying technology and 30 providing engineering, construction, and consulting services.

The contributions of the selected projects to domestic and international energy and environmental needs are significant. These contributions include:

- Completing demonstration and proving commercial viability of a suite of cost-effective SO_2 and NO_x control options capable of achieving moderate (50 percent) to deep (70–95 percent) emission reduction for the full range of coal-fired boiler types;
- Providing the database and operating experience requisite to making atmospheric fluidized-bed combustion a commercial technology at utility scale;
- Completing demonstration of a number of coal processes to produce high-energy-density, low-sulfur solid fuels and clean liquids from a range of coal types;
- Laying the foundation for the next generation of technologies to meet the energy and environmental demands of the 21st century—three IGCC plants in operation at three separate utilities; and successful demonstration of pressurized fluidized-bed combustion at 70 MWe and two larger scale demonstrations in progress; and
- Demonstrating significant efficiency and pollutant emission reduction enhancements in steel making, advanced combustion for combined SO_2/NO_x/PM control for industrial and small utility boilers, and innovative SO_2 control for waste elimination in cement production.

Exhibit 2-2
Clean Coal Technology Demonstration Projects by Solicitation

Project and Participant	Location
CCT-I	
Development of the Coal Quality Expert™ (ABB Combustion Engineering, Inc. and CQ Inc.)	Homer City, PA
LIMB Demonstration Project Extension and Coolside Demonstration (McDermott Technology, Inc.)	Lorain, OH
Advanced Cyclone Combustor with Internal Sulfur, Nitrogen, and Ash Control (Coal Tech Corporation)	Williamsport, PA
Enhancing the Use of Coals by Gas Reburning and Sorbent Injection (Energy and Environmental Research Corporation)	Hennepin and Springfield, IL
Tidd PFBC Demonstration Project (The Ohio Power Company)	Brilliant, OH
Advanced Coal Conversion Process Demonstration (Western SynCoal LLC)	Colstrip, MT
Nucla CFB Demonstration Project (Tri-State Generation and Transmission Association, Inc.)	Nucla, CO
JEA Large Scale CFB Combustion Demonstration Project (JEA)	Jacksonville, FL
CCT-II	
SNOX™ Flue Gas Cleaning Demonstration Project (ABB Environmental Systems)	Niles, OH
Demonstration of Coal Reburning for Cyclone Boiler NO_x Control (The Babcock & Wilcox Company)	Cassville, WI
SO_x-NO_x-Rox Box™ Flue Gas Cleanup Demonstration Project (The Babcock & Wilcox Company)	Dilles Bottom, OH
Cement Kiln Flue Gas Recovery Scrubber (Passamaquoddy Tribe)	Thomaston, ME
Advanced Flue Gas Desulfurization Demonstration Project (Pure Air on the Lake, L.P.)	Chesterton, IN
Demonstration of Advanced Combustion Techniques for a Wall-Fired Boiler (Southern Company Services, Inc.)	Coosa, GA
Demonstration of Innovative Applications of Technology for the CT-121 FGD Process (Southern Company Services, Inc.)	Newnan, GA
Demonstration of Selective Catalytic Reduction Technology for the Control of NO_x Emissions from High-Sulfur, Coal-Fired Boilers (Southern Company Services, Inc.)	Pensacola, FL
180-MWe Demonstration of Advanced Tangentially-Fired Combustion Techniques for the Reduction of NO_x Emissions from Coal-Fired Boilers (Southern Company Services, Inc.)	Lynn Haven, FL
CCT-III	
Commercial-Scale Demonstration of the Liquid Phase Methanol (LPMEOH™) Process (Air Products Liquid Phase Conversion Company, L.P.)	Kingsport, TN
10-MWe Demonstration of Gas Suspension Absorption (AirPol, Inc.)	West Paducah, KY
Healy Clean Coal Project (Alaska Industrial Development and Export Authority)	Healy, AK
Full-Scale Demonstration of Low-NO_x Cell Burner Retrofit (The Babcock & Wilcox Company)	Aberdeen, OH

Exhibit 2-2 (continued)
Clean Coal Technology Demonstration Projects by Solicitation

Project and Participant	Location
CCT-III (continued)	
Confined Zone Dispersion Flue Gas Desulfurization Demonstration (Bechtel Corporation)	Seward, PA
Blast Furnace Granular-Coal Injection System Demonstration Project (Bethlehem Steel Corporation)	Burns Harbor, IN
McIntosh Unit 4A PCFB Demonstration Project (City of Lakeland, Lakeland Electric)	Lakeland, FL
ENCOAL® Mild Coal Gasification Project (ENCOAL Corporation)	Gillette, WY
Evaluation of Gas Reburning and Low-NO_x Burners on a Wall-Fired Boiler (Energy and Environmental Research Corporation)	Denver, CO
LIFAC Sorbent Injection Desulfurization Demonstration Project (LIFAC–North America)	Richmond, IN
Integrated Dry NO_x/SO_2 Emissions Control System (Public Service Company of Colorado)	Denver, CO
Tampa Electric Integrated Gasification Combined-Cycle Project (Tampa Electric Company)	Mulberry, FL
Commercial Demonstration of the NOXSO SO_2/NO_x Removal Flue Gas Cleanup System (NOXSO Corporation)	On hold
CCT-IV	
Micronized Coal Reburning Demonstration for NO_x Control (New York State Electric & Gas Corporation)	Lansing and Rochester, NY
Milliken Clean Coal Technology Demonstration Project (New York State Electric & Gas Corporation)	Lansing, NY
Piñon Pine IGCC Power Project (Sierra Pacific Power Company)	Reno, NV
Pulse Combustor Design Qualification Test (ThermoChem, Inc.)	Baltimore, MD
Wabash River Coal Gasification Repowering Project (Wabash River Coal Gasification Repowering Project Joint Venture)	West Terre Haute, IN
Self-Scrubbing Coal™: An Integrated Approach to Clean Air (Custom Coals International)	Central City, PA
CCT-V	
Clean Coal Diesel Demonstration Project (Arthur D. Little, Inc.)	Fairbanks, AK
Clean Power from Integrated Coal/Ore Reduction (CPICOR™) (CPICOR™ Management Company L.L.C.)	Vineyard, UT
Kentucky Pioneer Energy IGCC Demonstration Project (Kentucky Pioneer Energy, L.L.C.)	Trapp, KY
McIntosh Unit 4B Topped PCFB Demonstration Project (City of Lakeland, Lakeland Electric)	Lakeland, FL

Exhibit 2-3
Geographic Locations of CCT Projects—Environmental Control Devices

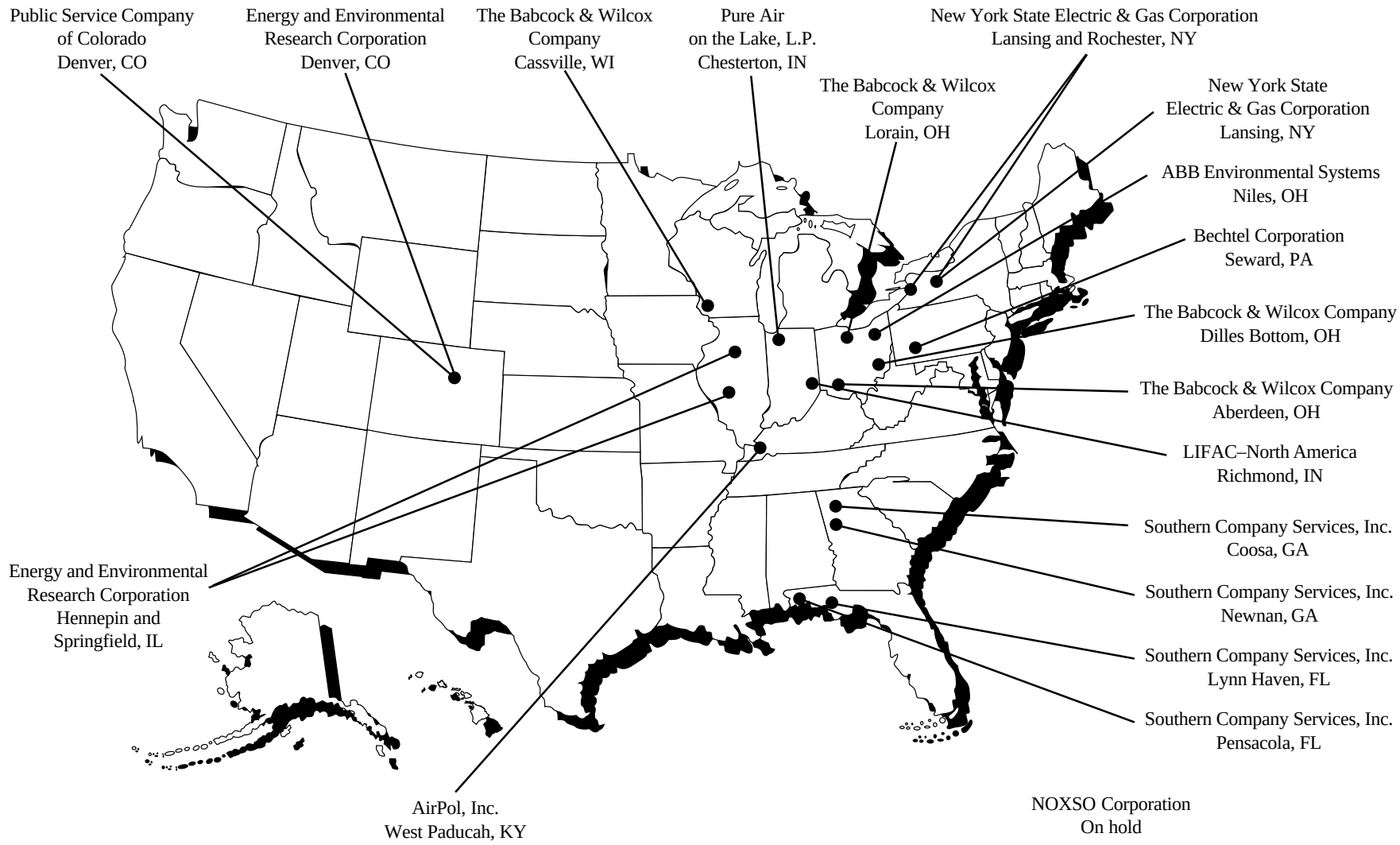


Exhibit 2-4
Geographic Locations of CCT Projects—Advanced Electric Power Generation

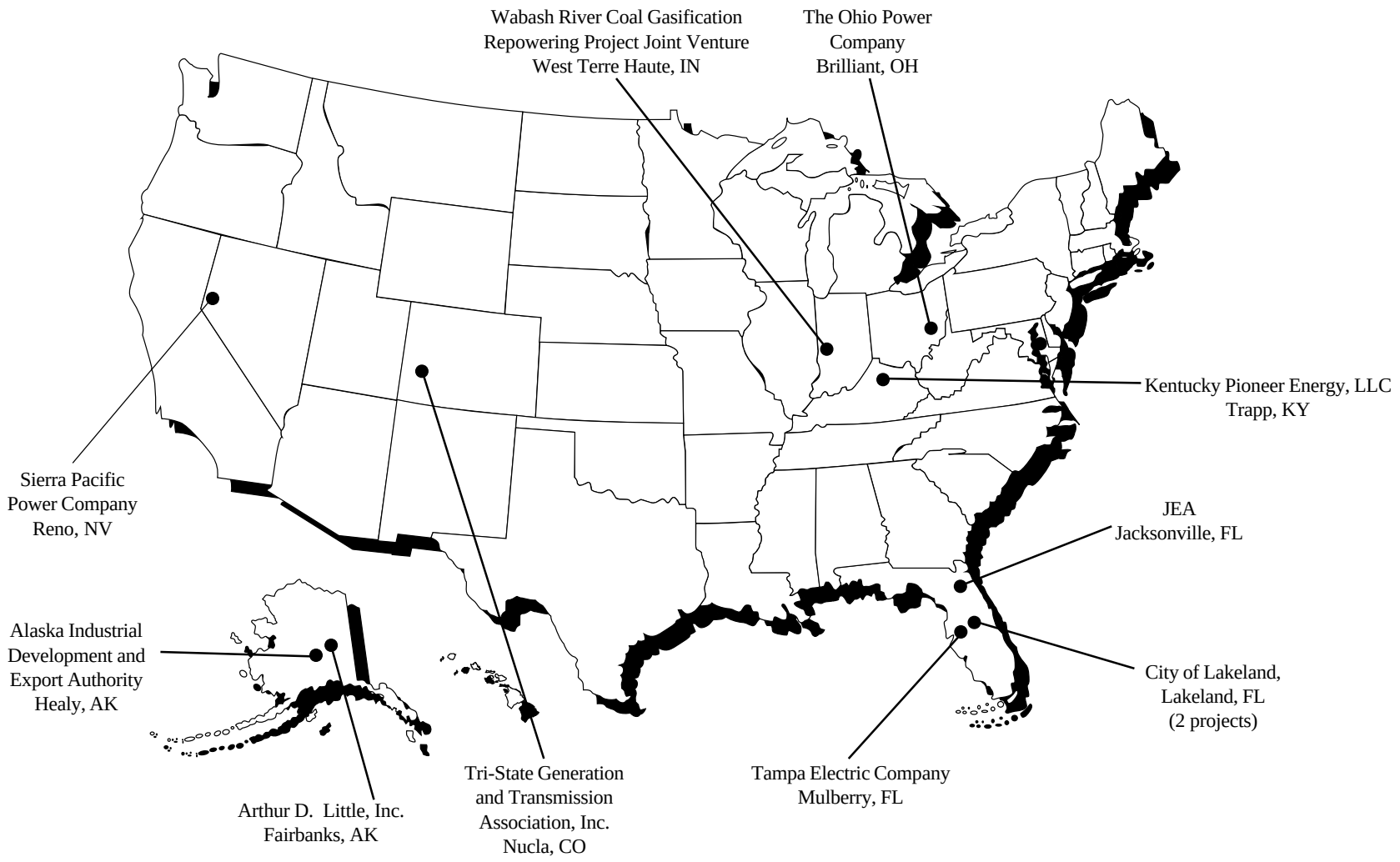


Exhibit 2-5
Geographic Locations of CCT Projects—Coal Processing for Clean Fuels

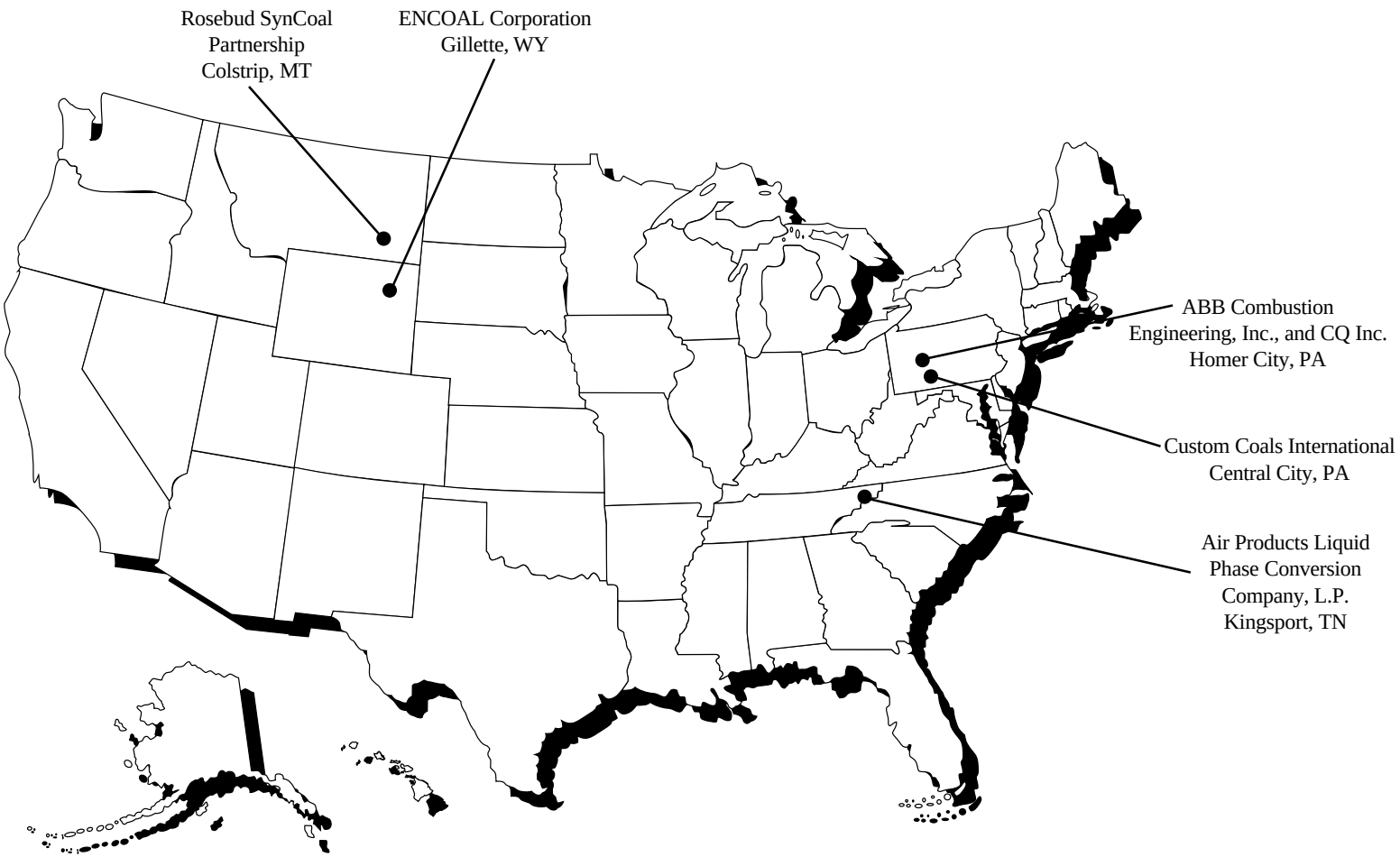


Exhibit 2-6
Geographic Locations of CCT Projects—Industrial Applications

Future Implementation Direction

The future implementation direction of the CCT Program focuses on completing the existing projects as promptly as possible and assuring the collection, analyses, and reporting of the operational, economic, and environmental performance results that are needed to affect commercialization.

Subsequent to the end of fiscal year 1999, but prior to publication of this report, the cooperative agreement for two demonstration projects expired—NOXSO Corporation and Custom Coals International are in bankruptcy and were not able to restructure and continue work under the CCT Program. Information on NOXSO Corporation's Commercial Demonstration of the NOXSO SO_2/NO_x Removal Flue Gas Cleanup System and Custom Coals International's Self-Scrubbing Coal™: An Integrated Approach projects are included in this report because there is data that readers may find beneficial. Furthermore, this report is based on the status as of September 30, 1999, and the expiration of these cooperative agreements occurred after that date. These two projects will not be included in future reports.

In fiscal year 2000, the following projects are forecasted to complete operations:

- Piñon Pine IGCC Power Project,
- Healy Clean Coal Project, and
- Pulse Combustor Design Qualification Test.

The body of knowledge obtained as a result of the CCT Program demonstrations is being used in immediate decision making relative to regulatory compliance, forging plans for meeting future energy and environmental demands, and developing the next generation of technology responsive to ever-increasing demands on environmental performance at competitive costs. An expanded portfolio of information will be forthcoming to make it easier for stakeholders and customers to sift through the already enormous amount of data resulting from the demonstrations.

Efforts will continue toward refining the effectiveness in responding to customer and stakeholder needs. Toward that end, as needs change, forums will be sought to obtain feedback particularly in view of utility restructuring, continued environmental concerns, and a burgeoning foreign market. Objectives are to ensure that CCT Program efforts are fully leveraged and that follow-on efforts under the OC&PS Research, Development, and Demonstration Program are appropriate.